Predicted Low-Loss Photonic Crystal Waveguides in SOI

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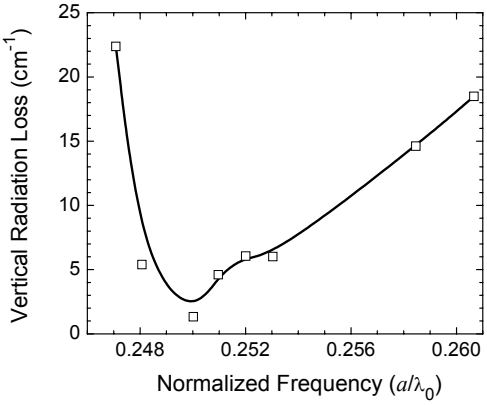
We have numerically demonstrated [1] that vertical radiation loss of photonic crystal waveguides on high index substrates can be reduced by shifting one side of the cladding along the direction of the waveguide by half of a lattice period, which is generally referred to as a type-B waveguide [1, 2]. In this summary, we improve over the structure by minimizing the dry etching depth to less than 1 micron. The waveguides modeled here were formed by indices of refraction consistent with a Si/SiO_2 waveguide with normalized thicknesses of 0.6 and 4.0.



A type-B photonic crystal waveguide eliminates the Fourier component of the photonic crystal lattice along the Gamma-Kappa axis, and reduces its magnitude for locations nearby. This leads to a reduction in the predicted radiation loss.

Fig. 1 shows the vertical radiation loss calculated with a three-dimensional finite-difference time domain method detailed in [2]. The minimum radiation loss is predicted to be 1 cm^{-1} and a bandwidth of 32 nm for loss of 5 cm^{-1} for a lattice constant, a, of 390 nm. This is more than an order of magnitude reduction in radiation loss compared to the type-A structure. In addition, this loss is a result of a photonic crystal geometry in which the holes of the lattice only need to be etched 780 nm deep.

[1] Wan Kuang and John D. O'Brien, *Reducing the out-of-plane radiation loss of photonic crystal waveguides on high-index substrates*, Optics Letters, **29**, 860 (2004)
[2] H. Benisty, *Modal analysis of optical guides with two-dimensional photonic band-gap boundaries*, J. Appl. Phys. **79**, 7483 (1996)
[2] Wan Kuang, C. Kim, A. Stapleton, W. J. Kim, and J. D. O'Brien, *Calculated out-of-plane transmission loss for photonic crystal slab waveguides*, Optics Lett., **28**, 1781 (2003)